

REMARKS

The specification and claims have been carefully reviewed in light of the third Office Action (final) of May 19, 2010.

In an effort to bring the claims into better form for Appeal, Claim 21 has been deleted because claim 1 already specifies that "said porous material is water-soluble." In light of this cancellation, Claims 23-25 were amended to have proper antecedent basis.

Care has been taken not to introduce any new matter.

The Present Invention

The present invention relates to a method for producing a water soluble porous polymeric material comprising the steps of; (a) providing a C/W emulsion comprising an aqueous phase, a water soluble polymeric matrix building material, a surfactant and liquid CO₂ phase; (b) at least partially freezing the aqueous phase; (c) gasifying CO₂ from the liquid CO₂ phase to form an intermediate porous material; (d) venting the gasified CO₂ from the intermediate porous material; and (e) freeze drying the intermediate porous material at least substantially to remove the aqueous phase and form the porous material. The present invention also relates to a water soluble porous material obtainable by the inventive method.

Obviousness – 35 USC § 103

Claims 1-6, 8-10, 12-21 and 23-30 have been rejected as being obvious over the combination of Ko *et al.* (US2003/0134918) and the paper published by Butler *et al.* (Adv. Mater. 2001, 13, No. 19, 1459-1463).

The Office Action maintains that addition of a cross-linking agent to the emulsion in Ko *et al.* is an *optional* step, and therefore because water-soluble polymers are “dispersed in the aqueous phase of the emulsion...the compositions of Ko *et al.* may be water-soluble porous materials” – see especially paragraph 10 of the Action, but also paragraphs 17 and 26.

Applicants respectfully traverse. There are at least **two major** differences between the present invention and the combination of teachings in Ko, et al., and Butler, et al., as follows:

(1) in the method of the present invention, a porous, **water-soluble** material is made, whereas the prior art teaches how to make **non-soluble** materials (achieved by providing cross-linked polymer) for use as **absorbent** articles;

(2) in the method of the present invention, polymer is provided in the emulsion in a **pre-formed** state so as to obviate the need for any chemical reaction step, whereas the prior art provides **monomers** in the emulsion which are subsequently polymerized – page 5, lines 10-11 state that “the method does not require the addition of any chemical initiators or monomers”.

Ko, et al. Is a Deficient Primary Reference

Ko, et al. is deficient in at least the following:

- (1) Ko et al. material is not soluble;
- (2) Ko et al. monomers are polymerized while in the emulsion, to form a crosslinked polymer in the final porous product.

Ko, et al., is concerned with the provision of ***absorbent articles***, especially ***absorbent composites*** having ***enhanced intake rates*** and ***retention properties***, and to a method making such absorbent composites – paragraph [0001]. According to paragraph [0002], manufacturers of personal care products such as diapers, feminine hygiene products and bandages strive to “find ways of improving the properties of the absorbent composite in order to reduce leakage”. Note, from the very outset of the document, there is **no** reference to a “soluble composite”.

According to the prior art, apparently, “products with a high content of superabsorbent material still leak, as many absorbent materials are unable to absorb a liquid at the rate at which the liquid is applied to the absorbent composite during use”. A solution to this problem has been to add fibrous material to the absorbent composite, nonetheless, “a poor choice of superabsorbent composite” (see paragraph [0003]). It is therefore stated in Ko, et al., that “to reduce leakage during the life cycle of the product, it is desirable to maintain the level of intake performance of the absorbent composite throughout the life of the product”.

Paragraph [0004] continues by stating that “high internal phase emulsion foams (HIPE) ... have been developed in an effort to create absorbent polymeric foams with enhanced fluid intake” and that such foams are prepared “by polymerizing water-in-oil emulsions”. However, it seems that difficulties can arise in extracting the oil phase that is entrapped by the polymer matrix after polymerization.

Ko, et al., therefore states in paragraph [0005] that there is a need for an ***absorbent composite*** that is capable of mass production which ***exhibits an improved***

fluid intake rate and/or improved fluid intake of multiple insults over the life of the composite.

Paragraph [0007] states that the problem with prior art water-in-oil (W/O) emulsion systems, in which “**the monomer and crosslinking agents are present** in the oil phase”, is that “subsequent removal of the aqueous liquid remaining in the foam requires pressing, thermal drying or vacuum dewatering”, and that the problem with prior art oil-in-water (O/W) emulsion systems is that it has proved difficult to extract “the oil phase in the polymer matrix after polymerization”.

In both paragraphs [0006] (summary of the invention) and [0008] (detailed disclosure of the invention), Ko, et al., states that the invention concerns “compositons and methods of making **absorbent polymeric foams** using super critical fluid technology”, i.e., the W/O and O/W systems taught in paragraph [0007] (which explicitly teaches the presence of crosslinking agents) are modified so as to completely or partially replace the oil with a super critical fluid such as CO₂.

Regardless of whether a HIPE or I-HIPE (inverse HIPE) route is followed, according to paragraph [0008], “after polymerization [of said monomers with said crosslinking agents] in the water phase occurs, the CO₂ is easily extracted from the polymer as a gas”. Furthermore, “by controlling the nature of the emulsion, and the polymerization process, nanopores can be created of very large gradient pores can be created such that one side of a foam sheet has large pores for good intake, while the opposing side has extremely small pores for high capillary pressure and retention”.

Therefore, clearly, Ko, et al., teaches the use of either a HIPE or I-HIPE emulsion route in which **monomers are polymerized while in the emulsion, to form a crosslinked polymer in the final porous product.**

Further evidence to support this teaching can be found in the remainder of the document. Paragraph [0018] provides a definition of an “in-situ SAP [superabsorbent

polymer] precursor monomer”, which is “used to produce a water absorptive polymer”, paragraph [0019] provides a definition of a “rubbery monomer” as a material which exhibits a glass transition temperature of about 40°C or lower, and paragraph [0022] defines a “cross-linking monomer” as a compound having “at least two polymerizing unsaturated groups in the molecular unit”, which will, as their name suggests, form a crosslinked polymer (possibly with the aid of an additional crosslinking agent).

Furthermore, paragraph [0027] defines what is meant by “absorbent capacity” – the amount of distilled water that a 1-inch cube (initial size) of absorbent fibrous material can absorb while in contact with a pool of room-temperature water and will retain after being removed from contact with the pool of liquid water and held on a metal screen and allowed to drip to 30 seconds. To be able to measure such a property, the absorbent material in Ko, et al., simply **cannot dissolve** on contact with water (i.e., be water-soluble). Indeed, in paragraph [0030] a definition of “water soluble” is provided – a material is considered to be water soluble when it substantially dissolves in excess water to form a solution, thereby losing its initial form and becoming essentially molecularly dispersed throughout the water solution, and “**a water soluble material will be free from a substantial degree of cross-linking, as crosslinking tends to render a material water insoluble**”. Following this, paragraph [0031] describes that “a water-swellable, water-insoluble” material is one that “when exposed to an excess of water, swells to its equilibrium volume but does not dissolve into the water ... [and] generally retains its original identity or physical structure, but in a highly expanded state, during the absorption of water and, thus, must have sufficient physical integrity to resist flow and fusion with neighbouring materials”.

Regarding HIPE foams, Paragraph [0038] builds on the teaching of paragraph [0037], which incorporates by reference the teachings of US 5,652,194, US 5,260,345, US 5,817,704 and US 5,268,224, all by The Procter & Gamble Company. In **each** of these references, the oil phase of a W/O emulsion system comprises:

- (a) a water-insoluble, monofunctional glassy monomer;

(b) a water insoluble, monofunctional rubbery co-monomer; **and**

(c) a water-insoluble polyfunctional crosslinking agent

to achieve a crosslinked, polymerized foam product.

Paragraph [0037] follows this teaching by stating that “the oil phase may comprise a supercritical fluid or a blend of a supercritical fluid and other fluids such as liquid oils”. However, it is clear that the use of the word “may” does not imply that the features following are optional – the very essence of the invention in Ko, et al., is complete or partial replacement of the oil in the oil phase of the W/O emulsion with a super critical fluid, e.g., CO₂, so this feature cannot be optional.

The Office Action position notwithstanding, Para. 38 of Ko et al. requires at least 10% cross-linking agent (lines 7-8). Specifically, paragraph [0038] states that “the oil phase of such HIPE emulsions may additionally comprise from about 67-97% by weight of a monomer component having:

- (a) from about 5 to about 40 % by weight of a substantially water-insoluble, monofunctional glassy monomer;
- (b) from about 30% to about 80% by weight of a substantially water-insoluble, monofunctional rubbery co-monomer; and
- (c) from about 10% to about 40% by weight of a substantially water-insoluble polyfunctional crosslinking agent component”.

Use of the word “may” refers to the percentage of each of the components (1), (b) and (c), which correspond to those components listed as essential above, and not to their inclusion *per se*. This is yet further evidence that a cross-linking agent is an essential component in Ko, et al., contrary to the Office Actions’ repeated assertion that a cross-linking agent is an optional component.

Regarding I-HIPE foams, according to paragraph [0040], "the chemical nature, makeup and morphology of the polymer material which forms the inverse HIPE foam structures of the present invention is determined by the types and quantity of the monomers, co-monomers and **crosslinkers** utilized in the emulsion". Again, this is evidence that a crosslinking agent *is* an essential component in Ko, et al., contrary to the Office Actions' repeated assertion that a cross-linking agent is an optional component.

All of the preceding teaching is brought together in paragraph [0055] which states that the water phase of the HIPE or I-HIPE includes:

- from about 20 % to about 80 % by weight of a monomer component;
- from about 0.01 to about 5% of a crosslinking agent; and
- from about 1% to 10 % of a water-soluble oxidizing initiator or a water-soluble reducing initiator; and
- from about 0.01 % to about 5 % of an emulsifier component.

There can be no question that a crosslinking agent must therefore be present and that the method of Ko, et al., is built upon providing monomers (which may themselves be water-soluble) in an initial emulsion which are subsequently polymerized to become a water-insoluble, crosslinked polymer in the final absorbent product.

Further final evidence of this can be found from paragraphs [0073] to [0085] which describe test methods for absorbent properties of the products formed. There are four tests, namely:

- (1) "Absorbency Under Load" test which is a measure of the liquid retention capacity of the absorbent product under mechanical load (not applicable if the product were to have dissolved);

- (2) "Free Swell Capacity" test which measures the amount in grams of an aqueous sodium chloride solution that can be absorbed by one gram of absorbent production in 1 hour under negligible load (again, not applicable if the product were to have dissolved);
- (3) "Absorbent Capacity" test – as described earlier (again, not applicable if the product were to have dissolved);
- (4) "Free Swell: AUL Ratio" test which determines how well the absorbent product is able to maintain its pore volume and capillary suction under load (again, not applicable if the product were to have dissolved).

Applicants would like to respectfully point out that soluble, absorbent polymers simply do not exist. As this fact would be readily appreciated to one skilled in the art, a *prima facie* case of obviousness is lacking, and the burden to show obviousness remains with the Examiner.

Butler, et al.

As acknowledged in paragraph 28 of the Office Action, Butler et al. does not contain all the features of the present invention. Also, as acknowledged in paragraph 21 of the Action, a person skilled in the art would turn to paragraph [0009] in Ko, et al., for a statement that the teaching of Butler, et al., can be adapted to improved HIPE polymerization processes used in the production of foams for absorbent articles, particularly using supercritical carbon dioxide to replace the oil phase in the HIPE foam-production processes to produce foams having higher capillary tension or other improved physical and interfacial properties relative to past HIPE foams.

Importantly, Butler, et al., also teaches the formulation of foam from an emulsion in at least one phase of which monomers are dissolved. The examiner describes the perceived teaching of Butler, et al., at some length in paragraph 20 of the Action. This

teaching is however *merely supplementary* to that in Ko, et al., and does not lead to the present invention because neither Ko, et al., nor Butler, el al., teaches the inclusion of a *pre-formed water-soluble polymer (other than monomers)* in an initial emulsion to form a porous, water-soluble polymeric material.

Furthermore, as previously pointed out, notwithstanding the Office Action position that Butler, et al., teaches use of crosslinked acrylamide-based polymers to produce the porous material therein, and that the teaching can also be applied to a *wider* range of materials, e.g., in one example the crosslinked acrylamide is substituted with 2-hydroxyethyl acrylate – see the bottom of the left-column on page 1461 – which the examiner states is a water soluble matrix. Applicants respectfully point out that, when the information is viewed in its entire statement, *this is not a water soluble matrix*. The notes underneath the table on page 1461 state that for Sample 4 (having note [c]), although 2-hydroxyethyl acrylate is used is place of crosslinked acrylamide (AM), the AM had been present in an 8:2 ratio with N,N-methylene bisacrylamide (MBAM). The combination of the 2-hydroxyethyl acrylate with MBAM *still leads to a crosslinked, water-insoluble, polymeric foam*, regardless of the fact that one of the monomers (2-hydroxyethyl acrylate) is water soluble prior to its polymerization.

Therefore, if even a person skilled in the art were to read and combine the teachings of these two documents, they would not have been led to the present invention. The prior art contains insufficient basis to direct one skilled in the art at the time the invention was made to the present invention. To assert otherwise can only be with the benefit of the disclosure of Applicants' invention that is the subject of this application.

Accordingly, a Notice of Allowance is earnestly solicited.

CONCLUSION

In light of the above remarks, applicants submit that the claims pending in the present application are in condition for allowance. Reconsideration and allowance of the application is respectfully requested. The examiner is invited to contact the undersigned if there are any questions concerning the case.

Respectfully submitted,
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